भारतीय मानक
Indian Standard

IS 17055 (Part 4) : 2020

मृदा-संचालन मशीनरी — सुरक्षा

भाग 4 बैकहो लोडरो की अपेक्षाएँ

(दूसरा पुनरीक्षण)

Earth-Moving Machinery — Safety

Part 4 Requirements for Backhoe Loaders

(Second Revision)

ICS 53.100

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June 2020 **Price Group 5**

Material Handling Systems and Equipment Sectional Committee, MED 07

FOREWORD

This Indian Standard (Part 4) (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Material Handling Systems and Equipment Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard supersedes the IS 17055 (Part 4) : 2018/ISO 20474-4:2017 'Earth moving machinery safety: Part 4 Requirements for backhoe loaders'.

This Indian Standard is published in several parts. The other parts in this series are:

Part 1 General requirements
Part 2 Requirements for tractor dozers
Part 3 Requirements for loaders
Part 5 Requirements for hydraulic excavators
Part 6 Requirements for dumpers
Part 7 Requirements for scrapers
Part 8 Requirements for graders
Part 9 Requirements for pipe layers
Part 10 Requirements for trenchers
Part 11 Requirements for earth and landfill compactors
Part 12 Requirements for cable excavators
Part 13 Requirements for rollers

The composition of the Committee responsible for the formulation of this standard is given in Annex C.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

EARTH-MOVING MACHINERY — SAFETY

PART 4 REQUIREMENTS FOR BACKHOE LOADERS

(Second Revision)

1 SCOPE

This standard (Part 4) specifies the safety requirements of wheeled and crawler backhoe loaders as defined in IS/ISO 6165. It is intended to be used in conjunction with IS 17055 (Part 1), which specifies generalsafety requirements common to two or more earth-moving machine families. The specific requirements given in this document take precedence over the general requirements of IS 17055 (Part 1).

1.1 This standard deals with all significant hazards, hazardous situations and events relevant to the earthmoving machinery within its scope (*see* IS 17055 (Part 1), Annex A) when used as intended or under conditions of misuse reasonably foreseeable by the manufacturer. It specifies the appropriate technical measures for eliminating or reducing risks arising from relevant hazards, hazardous situations orevents during commissioning, operation and maintenance.

2 REFERENCES

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards indicated *below:*

IS No/Other Publication	*Title*
IS/ISO 2330 : 2002	Fork-lift trucks — Fork arms — Technical characteristics and testing
ISO 6061:2008	Earth-moving machinery — Methods of measuring the masses of whole machines, their equipment and components
IS/ISO 6165 : 2012	Earth-moving machinery — Basic types — Identification and terms and definitions
IS 11252 : 1993/ ISO 6682 : 1986	Earth-moving machinery — Zones ofcomfort and reach for controls
IS/ISO 14397-1 : 2007	Earth-moving machinery — Loaders and backhoe loaders: Part 1 Calculation of rated operating capacity and test method for verifying calculated tipping load
IS/ISO 7096 : 2000	Earth-moving machinery — Laboratory evaluation of operator seat vibration
IS/ISO 7451 : 2007	Earth-moving machinery — Volumetric rating for hoe-type and grab-type buckets of hydraulic excavators and backhoe loaders
IS 12206 : 1993/ ISO 7546 :1963	Earth-moving machinery — Loaders and front loading excavator buckets — Volumetric ratings
IS/ISO 8643 : 2017	Earth-moving machinery — Hydraulic excavator and backhoe loader boom lowering control device — Requirements and tests
IS/ISO 9248 : 1992	Earth-moving machinery — Units for dimensions, performance and capacities, and their measurement accuracies
IS 17055 (Part 1) : 2018	Earth moving machinery safety: Part 1 General requirements
IS/ISO 14397-1 : 2007	Earth-moving machinery — Loaders and backhoe loaders — Part 1: Calculation of rated operating capacity and test methods for verifying calculated tipping load
ISO 14397-2 : 2007	Earth-moving machinery — Loaders and backhoe loaders — Part 2: Test method for measuring breakout forces and lift capacity to maximum lift height

3 TERMS AND DEFINITIONS

For the purposes of this standard, the terms and definitions given in IS 17055 (Part 1) and IS/ISO 6165 shall apply in addition of the following.

3.1 Backhoe Loader — Self-propelled crawler or wheeled machine having a main frame designed to carry both front-mounted equipment and rear-mounted backhoe equipment (normally with outriggers or stabilizers).

NOTES:

To entry:

a) When used in the backhoe mode, the machine is stationary and normally digs below ground level.
b) When used in the loader mode (bucket use), the machine loads through forward motion.
c) A backhoe work cycle normally comprises excavating, elevating, swinging and discharging of material. A loader work cycle normally comprises filling, elevating, transporting and discharging of material.

3.2 Compact Backhoe Loader — Backhoe loader (**3.1**) with an operating mass in accordance with ISO 6061 of 4 500 kg or less, designed to work in limited spaces with the associated needs for greater maneuverability.

3.3 Hydraulic Lift Capacity — Maximum mass that can be lifted in any arm position with the fork in horizontal position limited by the hydraulic circuit working pressure as defined in IS/ISO 14397-2.

3.4 Anchorage Point — Vertical point below the lifting device where the load force is applied or transposed.

3.5 Hydraulic holding Circuit Pressure Load — Maximum static pressure in a specific circuit, limited by a relief valve at a flow no greater than 10 percent of rated circuit flow.

3.6 Tipping Load — Static load at the balance point.

3.7 Hydraulic Lift Capacity — Maximum load that can be lifted at the bucket hinge pin with any hydraulic circuit activated, limited by the working circuit hydraulic pressure.

3.8 Lift Point Radius — Horizontal distance between the bucket hinge pin and the swing pivot centre.

3.9 Balance Point — Point at which the moment acting to overturn the machine with a specific load and lift point radius is equal to the moment of the machine available to resist overturning.

3.10 Overturning Moment — Moment when the balance point is reached.

3.11 Test Force — Force applied to the load cell either by the test weight or by applying hydraulic means.

4 SAFETY REQUIREMENTS AND PROTECTIVE MEASURES

4.1 General

Backhoe loaders shall comply with the safety requirements and protective measures of IS 17055 (Part 1), in as far as those are not modified by the specific requirements of this clause.

4.2 Operator's Station

4.2.1 *Minimum Space Envelope*

On backhoe loaders with a retractable rear window, the cab height above the seat index point (SIP) shall not be less than 920 mm, measured with the window retracted into the cab.

4.2.2 *Operator's Controls*

Clause **4.5** of IS 17055 (Part 1), applies with the following additions:

a) On backhoe loaders equipped with outriggers, an acoustic and visual warning device shall warn the operator when the travel control is engaged and the outriggers are not in the transport position as defined by the manufacturer. An acoustic and visual warning device shall warn the operator that the transmission is engaged when the operator's seat is not facing in the direction of the controls used to propel, for example, braking, steering. The operator shall be able to determine if the outriggers are in the transport position as defined by the manufacturer prior to engaging the travel control.
b) If the backhoe loader is provided with an alternative operator position with alternative travel controls, there shall also be control devices for braking and steering at this alternative position, which meet the performance requirements for the primary functions.

4.2.3 *Operator's Seat*

IS 17055 (Part 1), **4.4.1**, shall apply, in addition, the seat shall be in accordance with IS/ISO 7096, input spectral class EM 5 and EM 8 for compact backhoe loaders.

4.3 Warning Devices

IS 17055 (Part 1), **4.9**, first indent, applies with the addition that the sound level shall also be greater than or equal to 93 dB(A) at 7 m distance from backhoe swing centre to the rear. The operator shall be able to activate the warning device also from the backhoe operation position.

4.4 Stability

4.4.1 *General*

IS 17055 (Part 1) **4.11**, shall apply, with the additions given in **4.4.2** and **4.4.3** below.

NOTE — All rated capacities as defined hereafter are based on tests, calculations, or both, of machines on alevel and firm supporting surface.

The mass of the load, its density and the location of its centre of gravity, as well as the mass of the attachment and the quick coupler, if fitted, shall be included in the determination of the rated operating load and the size/capacity of the attachment.

In order to provide sufficient stability, the rated operating load in intended operations shall be determined as specified in **4.4.2** and **4.4.3**.

4.4.2 *Loader Portion*

4.4.2.1 *General*

The rated capacities of the backhoe loader used in loader applications shall be determined as follows, with the backhoe in its transport position as specified by the manufacturer.

The loader portion of the backhoe loader does not require a boom-lowering control device as defined in IS/ISO 8643.

4.4.2.2 *Bucket application*

The rated operating capacity shall be determined according to IS/ISO 14397-1.

The volumetric rating of bucket shall be determined according to IS 12206.

NOTE — The mass, volumetric rating of bucket and density of the material are taken into account when the bucket capacity is selected for a specific application.

4.4.2.3 *Fork application*

4.4.2.3.1 *General*

The rated operating capacity is based on the use of forks and shall be determined by the criteria specified in **4.4.2.3.2** and **4.4.2.3.3**.

4.4.2.3.2 *Stability assessments*

The tipping load shall be determined according to IS/ISO 14397-1 and IS/ISO 14397-2, with the fork in ahorizontal position. The rated load, as a percentage of tipping load, shall not exceed the applicable value as specified in Table 1.

Table 1 Stability Factors in Fork Application

(*Clause* 4.4.2.3.2)

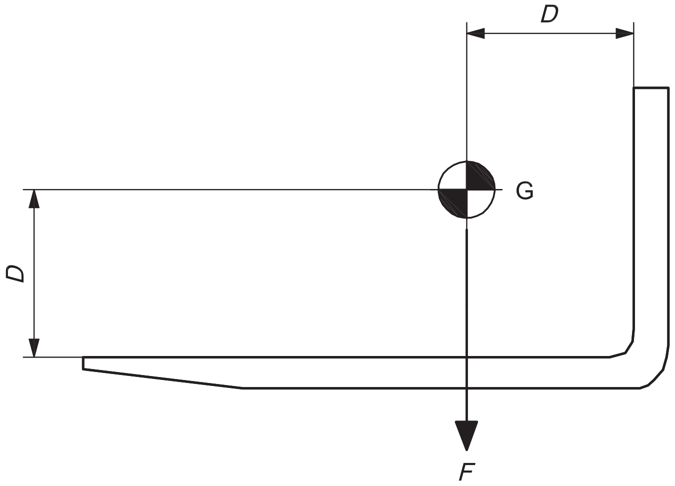
Rated Load Capacity as a Percentage of Tipping Load for Loader Portion	
Ground Condition	**Percentage of Tipping Force**
Rough terrain	60
Firm and level ground	80

Stability factors used to determine the rated operating load of the crawler backhoe loader shall not exceed 35 percent of the tipping load.

4.4.2.3.3 *Fork load centre of gravity*

Fork arms shall meet the performance requirements stated in **IS/ISO 2330**

The load centre of gravity distance, *D*, is determined as a point on the longitudinal centre line of the machine at half the distance from the most rearward point of the load opening to the tip of the fork (*see* Fig. 1).



Key

D	distance, mm
F	load, N
G	centre of gravity

FIG. 1 — LOAD CENTRE OF GRAVITY WITH FORK ARMS

4.4.2.4 *Log-handling application*

4.4.2.4.1 *General*

The rated operating capacity is based on a log grapple application and shall be determined according to IS/ISO 14397-1 [except for stability factor stated in **5.1** of IS/ISO 14397-1:2007, with the log grapple fitted]. The rated load as percentage of tipping load shall not exceed the applicable value specified in Table 2.

Table 2 Stability Factors in Log Handling

(*Clause* 4.4.2.4.1)

Ground Condition	Rated Operating Load Capacity as Percentage of Tipping Load	
	Wheeled Backhoe Loaders	Crawler Backhoe Loaders
Rough terrain	75	50
Firm and level ground	85	60

4.4.2.5 *Object-handling application*

The rated operating capacity is based on use of a lifting accessory or accessories and the attachment and shall be determined according to IS/ISO 14397-1.

4.4.2.6 *Other applications*

The rated load of derivative machinery shall be determined by the manufacturer according to the load specification given in **4.4.2.2** to **4.4.2.5**, considering the comparable hazard.

4.4.3 *Backhoe Portion*

4.4.3.1 *General*

Clause **4.11** of IS 17055 (Part 1), shall apply, with the following exceptions:

a) If the loader bucket is intended to increase the stability of the machine, the hydraulic circuits of the loader portion do not require locking devices.

b) The rated capacities of a backhoe loader used in backhoe applications shall be determined with theloader bucket and the outriggers placed on the ground (*see* Annex A). The hydraulic circuits of theloader portion do not require locking devices.

4.4.3.2 *Bucket and shovel application*

The rated lift capacity for a backhoe loader used in backhoe application with a bucket or shovel shall bedetermined in accordance with Annex A as the value according to **A-5.**

The volumetric rating of the bucket shall be determined according to IS/ISO 7451 or IS 12206.

NOTE — The mass, the volumetric rating of the bucket and the density of the material are taken into account when a bucket is selected for a specific application.

4.4.3.3 *Object-handling application*

4.4.3.3.1 *General*

The rated lift capacity of a backhoe portion used for object handling application shall be determined according to **4.4.3.3.2** to **4.4.3.3.4.**

4.4.3.3.2 *Rated lift capacity in object handling*

The rated lift capacity in object handling of the backhoe portion is defined in A-6.

4.4.3.3.3 *Rated lift capacity table in object handling*

A table of the rated lift capacity in object handling, established by the manufacturer, shall be provided.

The rated lift capacity table in object handling shall be generated with the rated lift capacity in object handling on different lift point radii, minus the mass of the attachment if necessary (*see* **A-8**). Thereshall be at least five different lift point radii. Minimum and maximum lift point radius shall always be included.

The tables shall be available at the operator's station for each object-handling configuration specified inthe operator's manual.

4.4.3.3.4 *Load safety devices*

The backhoe portion used in object handling operations with a maximum rated lift capacity of ≥ 1 000 kg, according to Annex A, or an overturning moment of ≥ 40 000 N-m, shall have provisions for the following.

a) An acoustic or visual warning device which indicates to the operator when the rated lift capacity/corresponding load moment is reached and continues as long as the lift capacity or load moment isexceeded. The rated lift capacity is defined in **4.4.3.3.3**.

   This device may be deactivated while the backhoe equipment is performing operations other than object handling. The activation shall be clearly indicated. The control device for activation and deactivation shall be within the operator's zone of comfort according to IS 11252. A warning sign shall be placed close to the control device indicating the need for activation during object handling.

b) A lowering control device on each raising boom and arm cylinder. For each arm cylinder the device shall be installed at the end which is pressurized to raise the arm away from the base machine. The lowering control device for each boom and arm cylinder shall be tested in accordance with IS/ISO 8643.

4.4.3.4 *Other applications*

The rated lift capacity of derivative machinery shall be determined by the manufacturer according to the load specification given in **4.4.3.2** and **4.4.3.3**, whereby the comparable hazard has to be consideredfor the special application.

4.5 Travelling and Transportation

Clause **4.15.6** of IS 17055 (Part 1), , shall apply with the addition that the backhoe portion shall be equipped with a device that securely locks the backhoe in transport position.

5 INFORMATION FOR USE

Clause **6.2** of IS 17055 (Part 1), shall apply, with the following additions to the operator's manual.

The manufacturer shall provide information on the rated operating load or bucket volume whenever applicable to

a) bucket applications according to **4.4.2.2**, for loader applications,
b) fork handling according to **4.4.2.3**, for loader applications,
c) log-handling applications according to **4.4.2.4**, for loader applications,
d) object-handling applications according to **4.4.2.5**, for loader applications,
e) other handling applications according to **4.4.2.6**, for loader applications,
f) backhoe bucket applications according to **4.4.3.2**,
g) backhoe object handling application according to **4.4.3.3**,
h) backhoe other application according to **4.4.3.4**,
j) instructions on how to securely lock the backhoe in the transport position,
k) backhoe rated object handling capacity table, e.g. in accordance with **4.4.3.3.3**, and
m) instructions regarding any other system(s) installed in the machine shall be provided.

6 BIS CERTIFICATION MARKING

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

ANNEX A

TEST METHOD FOR BACKHOE LOADER LIFT CAPACITY AT THE BACKHOE PORTION

A-1 GENERAL

Annex A specifies a test method to be used for determining the backhoe loader capacity when inbackhoe applications.

NOTE — A terminology specific to backhoe loaders is provided by ISO 8812, the most common backhoe loaders are illustrated in Annex B of this part of standard.

A-2 APPARATUS

A-2.1 Load Cell or Force Transducer, appropriate to the magnitude of the load to be measured.

A-2.2 Wire Ropes and Shackles, Pulley, Safety Chains and Adjustable Anchor Point (for example, slide rail)**.**

A-2.3 Pressure Gauge

A-2.4 Means for Measuring Linear Dimensions

Tolerances shall be in accordance with IS/ISO 9248.

A-3 TEST SITE

The test site shall consist of a substantially level (± 2 percent inclination), hard surface preferably of concrete with an anchor point and sufficient space for the load cell.

A-4 PREPARATION FOR TESTING

A-4.1 General

The machine shall be clean and equipped according to the manufacturer's specifications.

It shall be equipped with a quick coupler, if applicable, but without attachment. Tyre inflation and tyre ballast shall be as specified by the manufacturer. The fuel tank shall be filled to 50 percent capacity.

Prior to testing, the engine and hydraulic system shall be at the normal working temperature, and the hydraulic system pressures shall then be checked for compliance with the manufacturer's recommended hydraulic pressure settings.

A-4.2 Position

The machine shall be positioned on the test site as follows:

a) in the least stable position (for example, fully side-shifted or fully articulated);
b) with the oscillation of the articulated steering joint (if any) locked;
c) if it can be articulated horizontally, with the arm in the straight position; and
d) with stabilization devices engaged according to the manufacturer's specifications.

Outriggers and loader bucket shall be in a position such that the wheels are just clear of ground.

A-5 CAPACITY TEST

A-5.1 Load Cell

The load cell (A-2.1) shall be installed between the excavator bucket hinge pin and the anchorage points, vertically below the hinge pin.

A-5.2 Position of Boom and Arm

The boom and arm shall be so positioned that the line between the boom hinge pin and the bucket hinge pin is horizontal when the force is applied.

A-5.3 Test Procedure

A-5.3.1 *Step One*

The test force shall be progressively applied until either the:

a) tipping load is reached, or
b) hydraulic holding circuit pressure load is reached.

A-5.3.2 *Step Two*

After completion of step one of the test, the hydraulic lift capacity shall be measured.

A-5.4 Verification

The following shall be measured and recorded:

a) the lift point radius;
b) the tipping load;
c) the hydraulic holding circuit pressure load; and
d) the hydraulic lift capacity.

A-6 RATED LIFT CAPACITY IN BUCKET OR SHOVEL APPLICATIONS

The capacity for a backhoe loader used in a bucket or shovel application shall be either:

a) 75 percent of maximum load according to A-**5.3.1** a), or
b) the hydraulic lift capacity according to A-**5.3.2**.

Whichever is the lesser of the two.

A-7 RATED LIFT CAPACITY IN HANDLING CAPACITY

The rated object-handling capacity shall be either:

a) 75 percent of maximum tipping load according to A-**5.3.1** a), or

b) 87 percent of hydraulic lift capacity according to A-**5.3.2**.

Whichever is the lesser of the two.

A-8 RATED LIFT CAPACITY WITH ATTACHMENT

The rated lift capacity shall be determined with the backhoe in the centre position at maximum lift point radius, minus the mass of the attachment.

Backhoe loaders with side shift shall be measured both with the backhoe in the centre position and fully side-shifted.

ANNEX B

ILLUSTRATIONS

See Fig. **B-1** to **B-5**

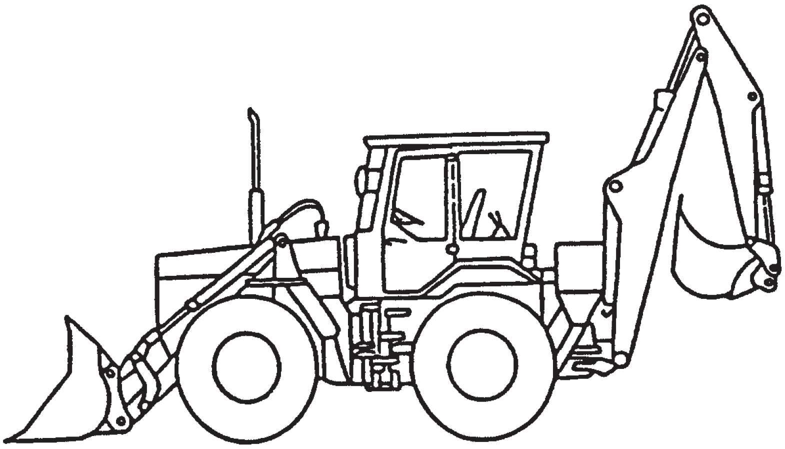


Fig. B.1 — Wheeled Backhoe Loader

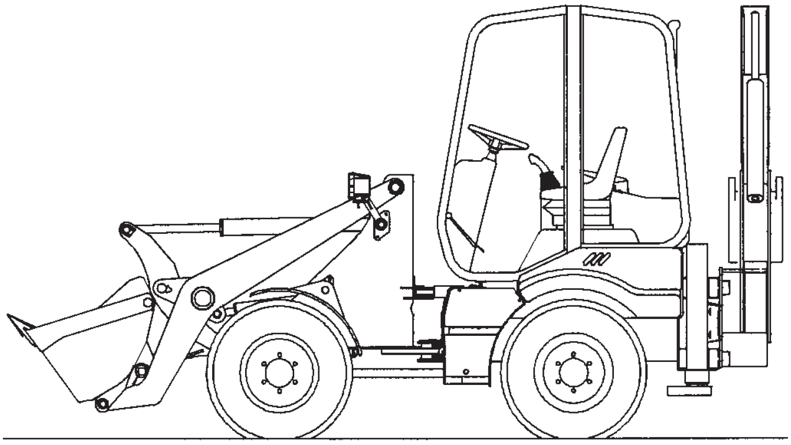


Fig. B.2 — Compact Wheeled Backhoe Loader

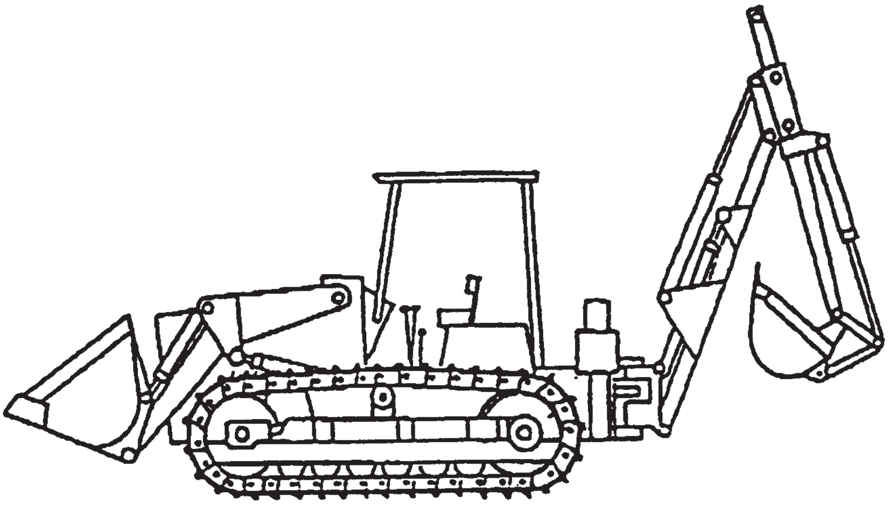


Fig. B.3 — Crawler Backhoe Loader

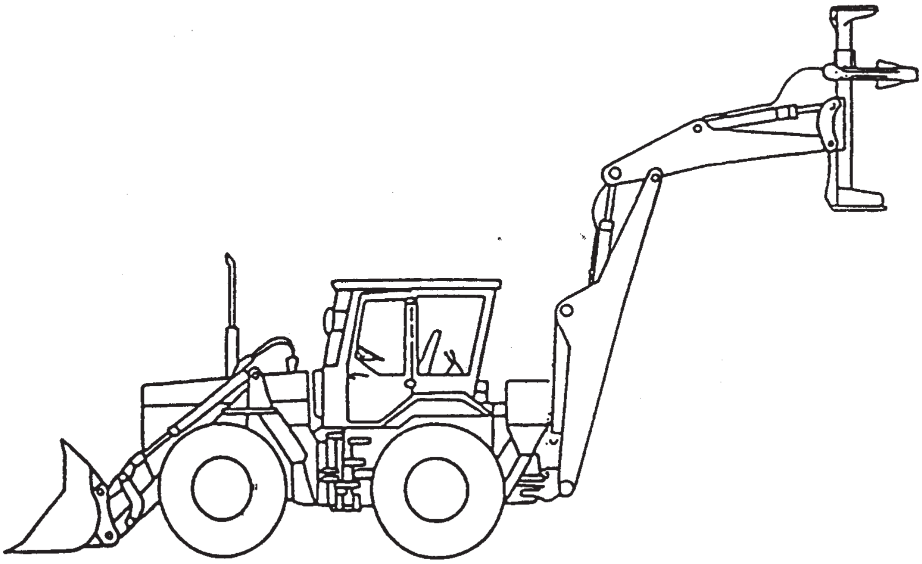


Fig. B.4 — Backhoe Loader with Pole-Erecting Attachment

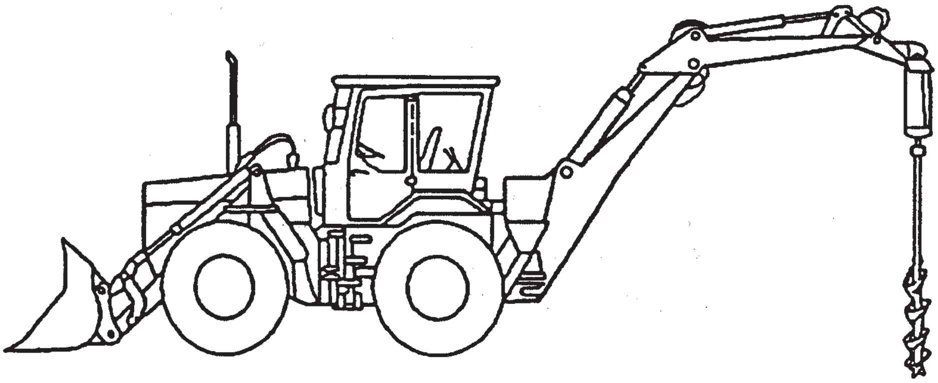


Fig. B.5 — Backhoe Loader with Earth Drill

ANNEX C

(*Foreword*)

COMMITTEE COMPOSITION

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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